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Baseline Television and Radio Signal Survey
&
Reception Impact Assessment

Brazennose House

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GTech Surveys Limited is a Midlands based broadcast and telecommunications consultancy conducting projects throughout the entire UK. We undertake mobile phone network, television and radio reception surveys (pre- and post-construction signal surveys), conduct broadcast interference and reception investigations, and support telecommunications planning work for wind energy developers, construction companies, architects, broadcasters and Local Planning Authorities.

In addition to radio interference modelling services and television reception surveys, we produce EIA and ES Telecommunications Chapters (also known as an 'Electronic Interference Chapter'); satisfying the requirements of Part 5, Regulation 18 (Parts 5a and 5b) of The Town and Country Planning EIA Regulations 2017. We peer review ES and EIA work, liaising with telecommunications providers (Arqiva, BT etc.) and advise developers with respect to associated Section 106 (Town and Country Planning Act 1990) and Section 75 (Town and Country Planning (Scotland) Act 1997) agreements.

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Executive Summary

A baseline (pre-construction) signal survey and reception impact assessment has been undertaken to determine the potential effects on the local reception of television and radio broadcast services from the proposed Brazennose House development in Manchester. Under Manchester City Council (MCC) planning guidance, any development over four storeys requires a TV and radio reception impact assessment. Consequently, this report has been produced to support the planning application submission and to provide the baseline reception data to assist with any further studies.

Accordingly, impacts to the reception of VHF (FM) radio, digital terrestrial television (also known as Freeview) and digital satellite television services (such as Freesat and Sky), have been assessed. Impacts to the reception of analogue television services have not been assessed in this study because analogue terrestrial television services were switched off in Manchester (Granada TV region) during 2009 and the rest of the UK by 2012.

Due to the existing excellent coverage and the robust nature of reception conditions in any theoretical signal shadow zone, the proposed development is not expected to impact the reception of digital terrestrial television (also known as Freeview) services.

Due to lack of viewers and satellite dishes in any theoretical signal shadow zone, the proposed development will not cause any interference to local digital satellite television reception, such as Freesat and Sky.

The proposed development is unlikely to adversely impact the reception of VHF(FM) radio broadcasts due to the existing good coverage in the survey area and the technology used to encode and decode radio signals.

Overall, the proposed development is unlikely to cause any interference to the reception of any television or radio broadcast platform. As no interference is expected, no mitigation measures are required to restore the reception of any broadcast service. This report provides the existing level and quality of radio and television signal reception in the survey area and can be used to support the planning application submission.

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1 - Introduction

This report outlines the findings of a reception impact assessment and pre-construction signal reception survey to determine the viewing preference of residents located around the proposed Brazennose House development and identifies what effects the proposed development may have on the reception of television and radio broadcast services. This report is prepared in support of a planning application submission for the development of six floors of office accommodation with three retail units and a landlord's reception. This report has been prepared by GTech Surveys Limited for The Prudent Assurance Company Ltd.

Under Manchester City Council (MCC) planning guidance, any development over four storeys requires a TV and radio reception impact assessment. Further guidance can be found in this document; "Full, Outline, Reserved Matters & Variation/Removal of Conditions Planning Applications - Is Your Application Valid?", September 2018, MCC. The requirement states;

> *Television Reception*
>
> *MCC planning guidance, any development over four storeys requires a TV reception impact assessment.*
>
> *Information on TV and radio reception and interference. Please provide a report on the possible interference created by the proposed development on TV and radio reception within the area. (Core Strategy Policy EN2)*

Additionally, national requirements under The National Planning Policy Framework (NPPF), February 2019 (Ministry of Housing, Communities & Local Government) states at paragraph 114, that local planning authorities should ensure that;

> *b) they have considered the possibility of the construction of new buildings or other structures interfering with broadcast and electronic communications services*

A desktop study was first undertaken, based on broadcast transmission information, plans of the Proposed Development and maps of the area. The relevant TV and radio signal survey area for the Proposed Development was identified and a site visit was then subsequently conducted to establish the baseline television reception conditions. Modelling techniques and field assessments of viewers' choice of television and radio transmitter were then used to predict the potential effects upon television and radio broadcast reception in the area. The impacts from the Proposed Development are consequently analysed, and together with various mitigation options, conclusions are drawn on the overall effects of the Proposed Development on television and radio broadcast service reception for local residents.

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This study was undertaken during April 2021 to investigate whether the Proposed Development could cause interference to local television and radio broadcast reception. The effects on VHF (FM) radio, digital terrestrial television and digital satellite television service reception are discussed. The report also details the baseline reception conditions for future reference. Figure 1 shows the location of the site.

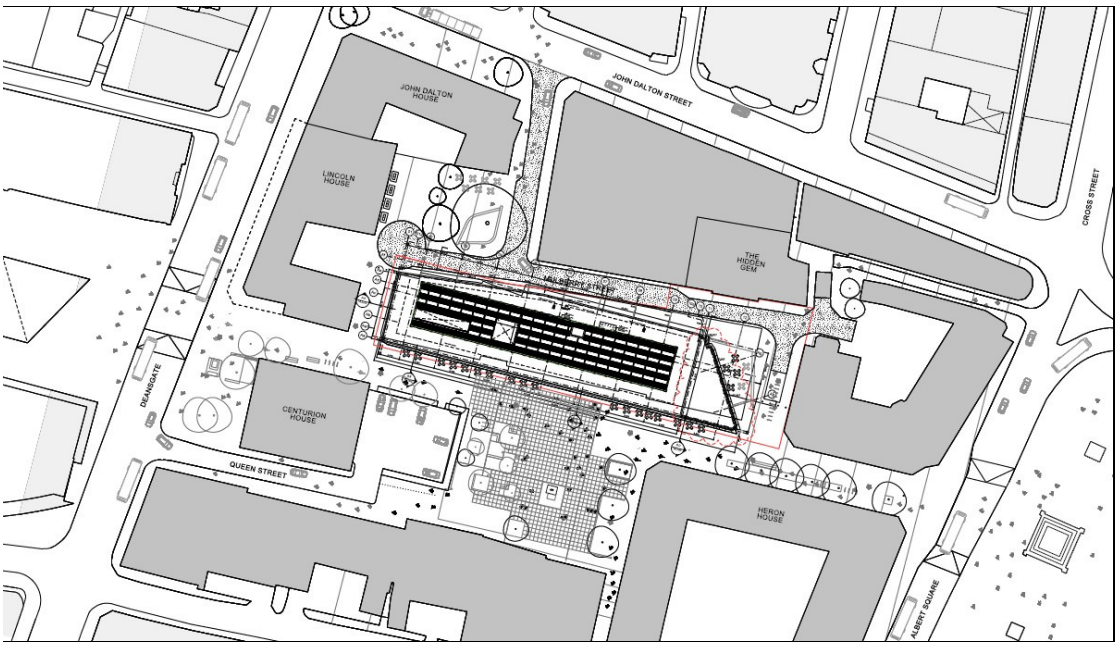

Figure 1 - The Planning Application Boundary Line (Delineated in red)

This report follows the following structure:

Chapter 1 introduces the work

Chapter 2 discusses the different forms of structure generated television and radio interference and how these can impact the reception of different television and radio broadcast platforms

Chapter 3 describes the available television and radio services in the survey area

Chapter 4 describes the pre-construction television and radio reception conditions around the Site

Chapter 5 describes the predicted impacts of the proposed development upon television and radio broadcast reception before any mitigation measures are applied

Chapter 6 describes any suitable mitigation measures for any affected TV viewer or radio listener

Chapter 7 presents the conclusion

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2 - The Mechanisms of Interference to Television and Radio Broadcast Services

Terrestrial Television Services

Any structure will produce two zones of potential disruption to television reception. One zone is where the development creates a ‘shadow’ (affects all television broadcast platforms) and the other where it gives rise to a ‘reflection’. At the frequencies used for broadcasting, the processes of creating a ‘shadow’ or a ‘reflection’ are somewhat more complicated than with visible light but thinking of the problem in these terms is still a helpful way of approaching the matter.

Signal ‘Shadowing’ Effects

In the area behind the structure, the television transmitter is effectively screened from the viewer and the strength of the signal is reduced - Figures 2 and 3.

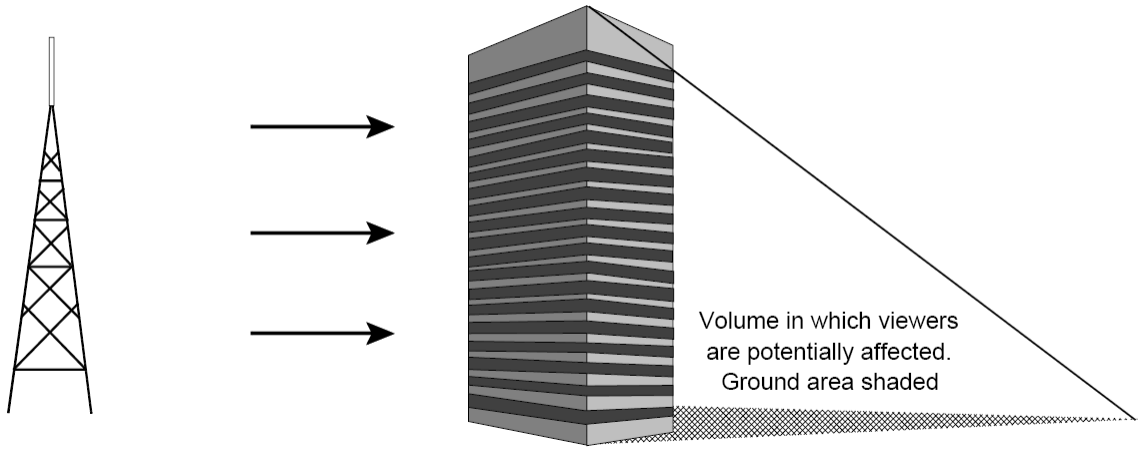

Figure 2 - Affected area in the ‘shadow’ zone behind the structure

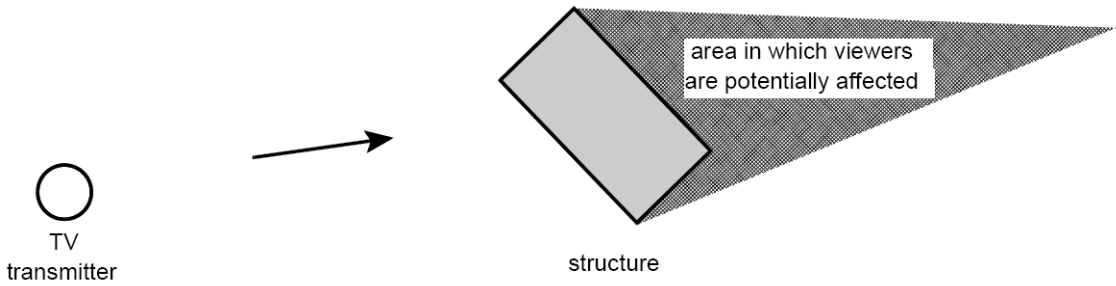

Figure 3 - Plan view of the ‘shadow’ zone

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Television signals do not create such a ‘hard’ shadow as visible light, and for the purposes of explanation, a ‘shadow’ zone must be considered which is divided into three sub-zones.

i. Within a few tens of metres from a solid structure, over the region where optical view of the transmitter is lost, the reduction in signal strength is critically dependent on the specific design and composition of the structure. For most brick and concrete buildings, the reduction can be severe and, in some cases, almost total if existing reception conditions are poor.

ii. Further away from the structure (e.g. beyond 25 to 50 metres, but this varies depending on its size) the limit of the ‘shadow’ zone and signal reduction are determined by diffraction at the edges of the structure and reflection off surrounding structures. The simple condition of whether or not a location has an optical view of the transmitter is not enough to classify the potential interference zone adequately. In general, the effect is that the signal appears to bend around the sides of the structure; the shadow zone reduces in size and the signal strength is reduced by much less than simple ray optics would suggest.

iii. Even further away from the structure (e.g. 250m) complex multiple reflections and diffraction, caused by structures in the locality, may result in the ‘shadow’ zone becoming almost non-existent, against interfering signals that arrive on significantly different bearings. This can result in an increase in the ratio of wanted to unwanted signal as presented to the television receiver.

Signal ‘Reflection’ Effects

The second zone of potential interference is produced by ‘reflection’ or ‘scattering’ of the incident signal, see Figure 4.

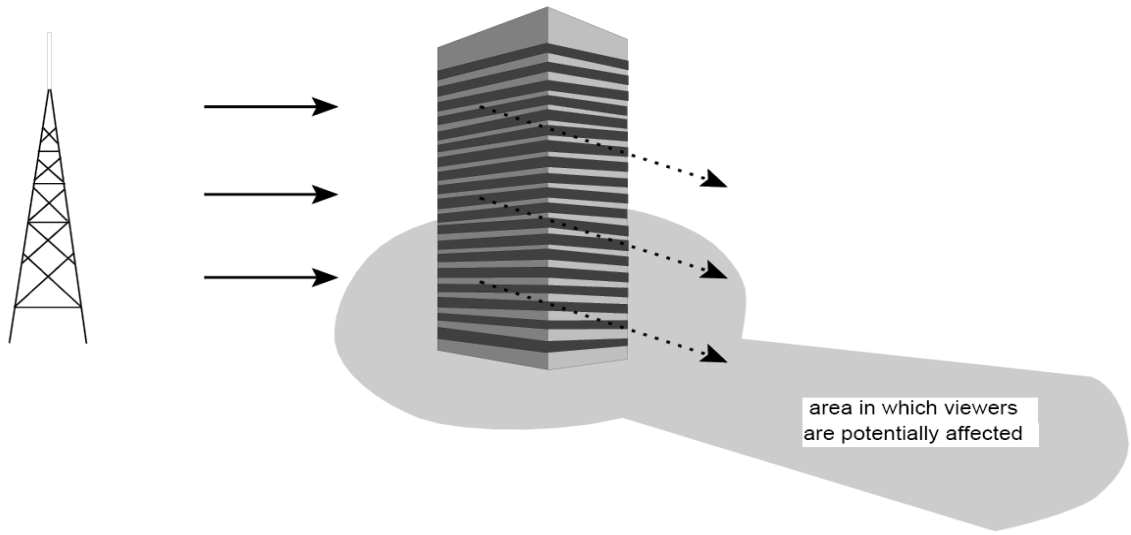

Figure 4 - Affected areas in the ‘reflected’ zone of the structure

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Consider Figure 5, the direct signal travels a distance P1 to the viewer, whilst the signal reflected from the structure travels slightly further, distance (P2 + P3). Although travelling at the speed of light, the different path lengths can mean that one signal arrives with a significant delay relative to the other. This results in a degradation in signal quality.

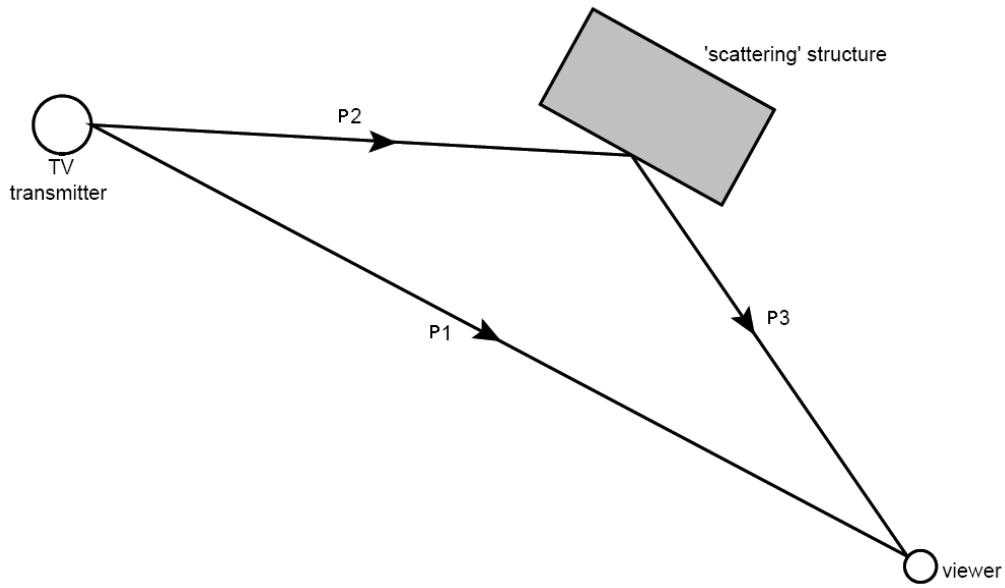

Figure 5 - Direct and Indirect Signal Paths

To avoid interference, it is necessary to ensure that the ratio of wanted signal along the direct path (P1) to the unwanted signal along indirect paths (P2+P3) is sufficiently high. Domestic TV receiving antennas generally have a significant directional response to incoming signals, which means that the antenna may discriminate against interfering signals that arrive on significantly different bearings. This can result in an increase in the ratio of wanted to unwanted signal, as presented to the television receiver.

Digital Terrestrial Television (DTT) - Freeview

The digital television broadcast platform offers many advantages over older analogue broadcast technologies. Due to the way picture signals are encoded and broadcast, digital television offers a much more resilient platform against interference. The construction of digital signals ensures that they are much more impervious to the effects of interference from indirect secondary reflections, which consequently ensures good quality and coherent data stream integrity at the receiver, resulting in an interference free picture. Disruption to DTT services is normally caused by a poor-quality receiving antenna system or locally generated wideband electrical noise. Signal blocking caused by buildings can also degrade received signal quality.

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Digital Satellite Television Services - Freesat & Sky

Digital satellite television services are provided by geo-stationary earth orbiting satellites positioned above the equator. To ensure good reception of digital satellite television services, satellite receive antennas (satellite dishes) are normally positioned away from trees and other clutter and are orientated to face the southern (south-southeast) skies.

Disruption to digital satellite television services is normally caused by an obstruction on the line of sight from the satellite to the receive antenna e.g. a tall building or tall trees. Adverse weather can also influence reception. In the United Kingdom, Freesat and Sky services come from the 28.2 degrees east ASTRA satellite cluster.

Figure 6 below shows typical clearance distances and obstruction heights for interference free satellite television reception.

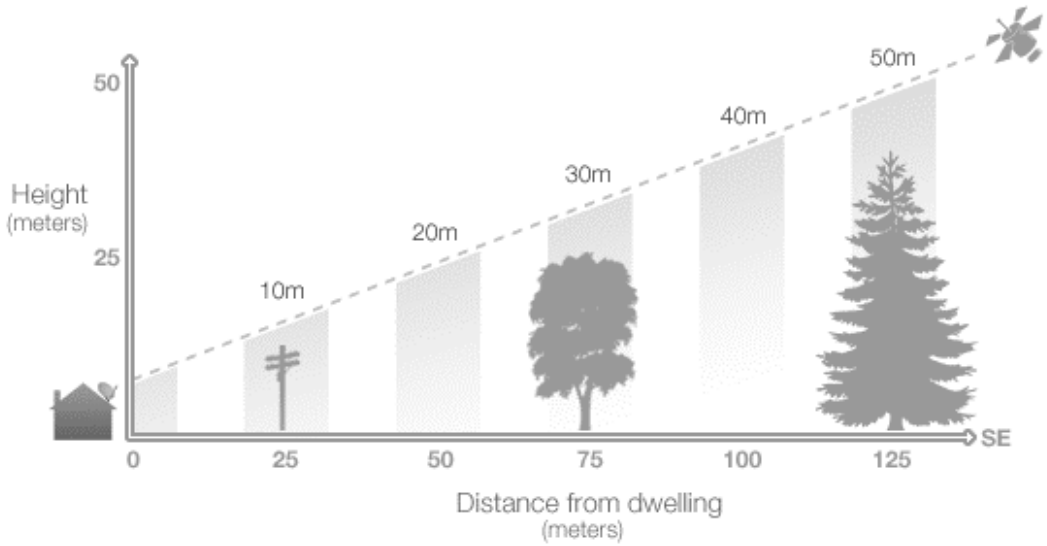

Figure 6 - Typical Clearance Distances and Obstruction Heights for Interference Free Satellite Television Reception

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VHF (FM) Radio

VHF (FM) radio services are broadcast from similar structures as terrestrial television services. Many things can cause radio interference, however simple remedies exist that can quickly reduce the effects. Most reception problems on FM radio are caused either by a weak signal or by some kind of interference.

Radio transmission signals will reflect into ‘shadow’ areas and also reflect from structures to cause ‘multi-path’ effects. The effect of multiple signals is to create zones of signal cancellation and signal enhancement. This is often demonstrated by the need to carefully position portable radio receivers for good reception or the fluctuation in signal quality whilst listening to VHF (FM) broadcasts in a vehicle. Due to the wavelength of the VHF (FM) signal (at 100 MHz, the wavelength is 3 metres), zones of interference can quickly and easily physically move around, as the interference is generated from the sum interaction of all incoming signals. Consequently, prediction of VHF (FM) interference is not practically possible due to the complex interaction of reflected signals with wanted signals, the design of radio receivers and radio signal propagation characteristics.

Buildings rarely cause radio interference but there is little that can be done during the design stage to reduce any adverse effects. Due to the lower frequencies in use for radio transmission (with respect to television services) and the methods by which the radio signals are encoded, it is very unlikely that a new structure in an already cluttered urban environment will disrupt the reception of radio services.

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3 - Available Television and Radio Broadcast Services

Terrestrial Television Services

The area around the Site is no longer served by analogue television transmissions due to the completed Digital Television Switchover. All analogue services were switched off in the Granada television region during 2009.

Digital Terrestrial Television (DTT) - Freeview

The survey area is served by DTT services (Granada TV region) from the Winter Hill transmitter (grid reference SD 66053 14463), on a bearing of 312° (with respect to true north) and 24km away. The Winter Hill transmitter is shown with respect to the site in Figure 7. Technical transmission information for each digital television service broadcast from the Winter Hill transmitter site is detailed in Table A, found in the Appendix - *Television Transmission Frequencies*.

Up to date technical information regarding the Granada TV region and Winter Hill transmitter group can be found on the Digital UK website - http://www.digitaluk.co.uk

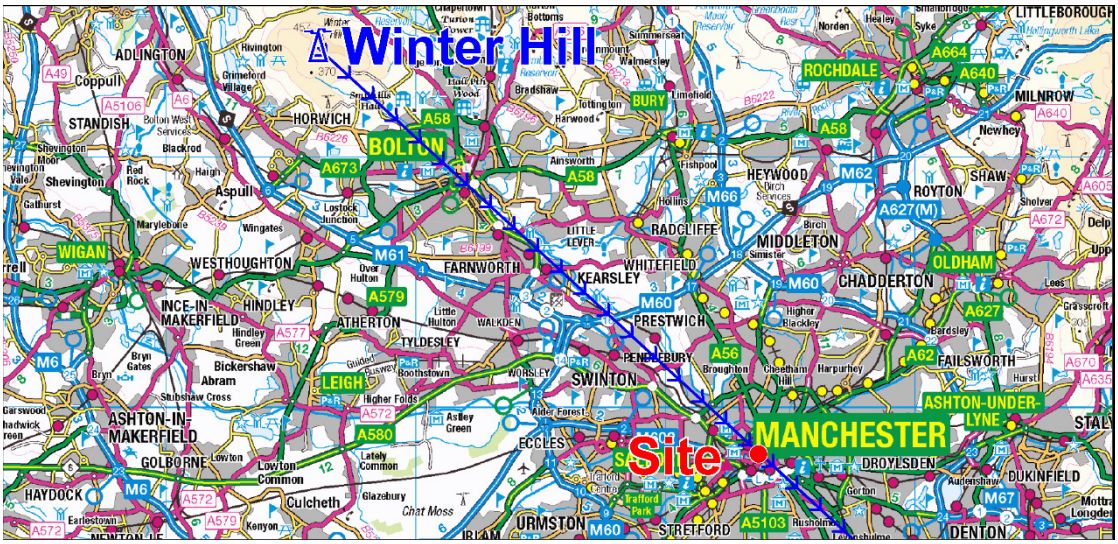

Figure 7 - The Locations of the Winter Hill Transmitter, the Site and the direction of the incoming DTT signals at the Site (indicated by the blue arrowed line)

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Non-Terrestrial Television Services (Digital Satellite Television)

For the reception of the 28.2 degrees east ASTRA satellite cluster (Freesat and Sky services), dish elevations of 22.8 degrees are required at this latitude. Optimal receive dish azimuths are 143.8 degrees with respect to true north (approximately southeast).

VHF (FM) Radio

The areas around the Site are served by VHF (FM) radio services of

BBC Radio 1, 2, 3, and 4 from the Holme Moss transmitter (NGR SE 09550 04050)

Technical transmission information for each radio service broadcast from the Holme Moss transmitter are detailed in Table B in the Appendix - *VHF (FM) Radio Transmission Frequencies.*

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4 - Survey Methodology & Description of Baseline

Due to the complex nature of television interference in cluttered urban environments, field investigations must be undertaken in the general area around a site to fully evaluate any potential effects. In this study, field measurements were undertaken up to two kilometres away from the Site, however, the study mainly focused around the Site and areas to the immediate northwest and southeast. Additionally, investigations are carried out in all areas where predicted (modelled) interference may occur. These are identified in Figure 8, and the measurements are detailed in Tables C and D, found in the Appendix - *Signal Measurements*. The following data was recorded:

- Field strength and technical signal measurements of DTT transmissions from the main serving transmitter
- Viewing preference (choice of television transmitter) of residents in all areas visited
- Field strengths of VHF (FM) radio transmissions from the serving transmitter

All television measurements were carried out using a UHF log-periodic receive antenna, mounted on GTech Surveys's broadcast survey vehicle, at a receive height of 10 metres above ground level (AGL), industry standard height for such work. VHF (FM) radio field strength measurements were taken with a resonant half wavelength folded dipole antenna at 2 metres AGL, industry standard height for such work. During the survey, no assessment was made of reception conditions within viewers' homes. Equipment details are detailed in the Appendix - *Survey Equipment*.

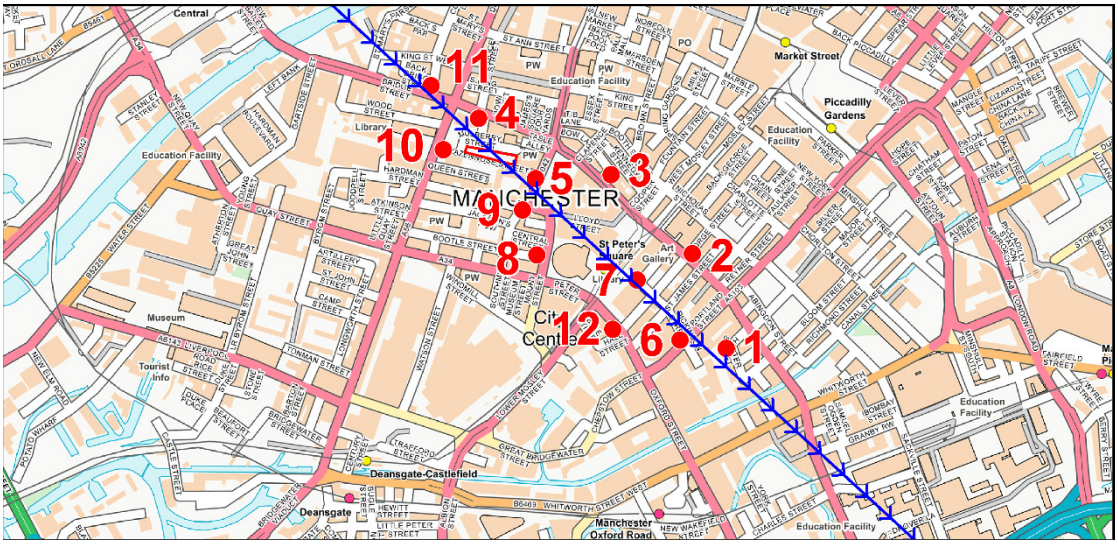

Figure 8 - Surveyed Locations. The blue arrows indicate the direction of the incoming DTT signals from Winter Hill transmitter. The Site is delineated in red

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Survey Results and Observations

In general, building use around the Site is mainly residential with some commercial use. When visible during the survey, all signal receive antenna systems are mounted on rooftops, ensuring optimal reception conditions. Terrestrial television antennas are directed towards the Winter Hill transmitter.

Digital Terrestrial Television - Freeview

DTT services were available at all surveyed locations from the Winter Hill transmitter. At all locations, received signal levels were in excess of recommended minimum amounts and the technical quality of received signals was found to be good[1]. DTT services currently provide very good coverage and service throughout the study area.

Digital Satellite Television - Freesat & Sky

During the survey, few satellite dishes were seen due to the building use in the study area. More dishes may be mounted on rooftops and at the rear of properties; however, these would not be visible from the street. No existing interference has been identified for any satellite television platform.

VHF (FM) Radio

VHF (FM) radio reception conditions were deemed to be good[2] throughout the study area. In-car reception was deemed to be good at all locations. This is due to the proximity of the Holme Moss high-power radio transmitter with respect to the site.

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1 - Signal levels as specified by the *Code of Practice Confederation of Aerial Industries (CAI) COP 01 - Installation of Terrestrial and Satellite TV Reception Systems (MDU & Commercial), CAI, January 2021*

Additional technical information regarding the Freeview signal can be found in the Appendix - *An Overview of Signal Measurements*

2 - Minimum Recommended Field Strengths for Acceptable Levels of VHF (FM) Radio Service

Monophonic audio - 40 dBµV/m
Stereophonic audio (excellent quality) - 54 dBµV/m

Source - https://www.ofcom.org.uk/__data/assets/pdf_file/0013/54310/annex-f.pdf

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5 - Predicted Impacts and Effects

Methodology

To assess the effects of the proposed development upon television and radio broadcast service reception, the structures were considered to create interference to services in the immediate areas around the Site, in signal reflection areas and in the signal shadow zones. These methods, used in conjunction with broadcast transmission information, development plans, maps of the study area and modelling techniques, contribute towards predicting the potential effects upon television and radio broadcast reception in the study area.

The field survey then investigated the areas identified as being at risk of interference and assessed all available services and the transmitter viewing preferences of residents in order to determine if the computed risk is practically valid. The collected data was finally used to determine what actual risks exist and what viable solutions are available to minimise any adverse effects. The predicted effects on broadcast reception are discussed below and summarised in Table 1.

Digital Terrestrial Television - Freeview

Digital television services are much less affected by signal reflections[3]. Due to the existing robust coverage in the survey area and ability of the received DTT signal to overcome multipath interference, the proposed development is not expected to have any adverse effect upon the reception of Freeview television services. No mitigation measures are required because no interference effects are thought to exist.

Digital Satellite Television - Freesat and Sky

Tall structures, trees and buildings can disrupt digital satellite television reception by causing obstructions on the line of sight to the signal receive dish from the serving satellite. This is discussed further in Chapter 2.

Using the mathematical tangent function and based on the height of the proposed development, the angle and orientation of the incoming satellite signals, theoretical signal shadow zones for the 28.2E ASTRA satellite cluster are up to 75m from the base of the proposed building. This area extends in a northwesterly direction (323.8 degrees with respect to true north) from the building's base. However, as there are no satellite dishes located in this area, interference cannot occur.

3 - Whilst less prone to signal reflection generated interference, modelling parameters assume that all installed antenna systems are mounted at least 10m AGL and installed to a modern standard, with all components meeting CAI quality standards. Antennas mounted at lower heights and substandard installations will be more prone to the effects of interference from external sources.

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VHF (FM) Radio

Modelling VHF (FM) radio interference in a cluttered urban environment is not possible due to the number of constantly changing variables. VHF(FM) broadcast radio reception is robust throughout this part of the country; evident by the survey results and signal availability with a typical car radio. Whilst any structure will change local signal propagation characteristics, due to the technical methods involved with encoding and receiving the transmissions, reception remains possible. Overall, the proposed development is not expected to impact the reception of VHF (FM) radio broadcasts.

Broadcast platform	**Area(s) of predicted interference**	**Risk of interference & reasoning**	**Mitigation**
DTT (Freeview)	Non-identified	No because coverage is robust	N/A
Digital Satellite TV (Freesat & Sky)	74m to the NW of the proposed building	No because there are no satellite users located in this area	N/A
VHF(FM) Radio	Non-identified	No because coverage is robust	N/A

Table 1 - Summary of Predicted Interference

Predicted Effects - Conclusions

The proposed development is not expected to cause any interference to the reception of digital terrestrial television (Freeview) services.

No interference to the reception of digital satellite television (Freesat and Sky) services is expected.

The proposed development is not expected to affect VHF(FM) radio reception.

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6 - Mitigation Measures

As no interference to the reception of any television or radio broadcast platform has been identified, no mitigation measures are required to restore broadcast service reception.

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7 - Conclusions

A desktop-based study and baseline reception survey have been performed to assess the possible effects and impacts on the reception of television and radio broadcast services from the proposed Brazennose House development in Manchester. The study has focused on the reception of VHF (FM) radio and the two television broadcast platforms that could possibly be impacted by the proposed development - digital terrestrial television and digital satellite television services.

Digital Terrestrial Television (DTT) - Freeview

Due to existing excellent coverage and robust nature of the DTT signal in the surveys area, the Proposed Development is not expected to have any adverse effect upon the reception of Freeview television services.

Digital Satellite Television - Freesat & Sky

Due to lack of viewers and satellite dishes in any theoretical signal shadow zone, the proposed development will not cause any interference to local digital satellite television reception.

VHF(FM) Radio

Due to the existing good coverage and robust technical nature of the broadcast radio network with respect to building-generated signal interference, the Proposed Development is not expected to affect the reception of VHF(FM) radio services.

Overall, the Proposed Development is unlikely to cause any interference to the reception of any television or radio broadcast platform. As no interference is expected, no mitigation measures are required to restore the reception of any broadcast platform. This report provides the existing level and quality of radio and television signal reception in the survey area and can be used to support the planning application submission.

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APPENDIX

Television Transmission Frequencies

VHF (FM) Radio Transmission Frequencies

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Calculation of Received Field Strength

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Television Transmission Frequencies

Digital TV Multiplex	Multiplex Operator	UHF Channel Number *	Channel Frequency Fc (MHz) **	Transmitter Power (kW)
BBC A	BBC	32	562.000	100.0
D3&4	Digital 3 & 4	34	578.000	100.0
BBC B - HD	BBC	35	586.000	100.0
SDN	SDN	29	538.000	100.0
Arqiva A	Arqiva	49	698.000	100.0
Arqiva B	Arqiva	37	602.000	100.0
COM7 - HD	Arqiva	55	746.000	22.9

Table A - Winter Hill Digital Terrestrial Television Services

Public Service Broadcaster (PSB) Digital Multiplexes
Commercial (COM) Digital Multiplexes

* - Digital multiplexes with a "+" or "-" sign operate with a frequency offset making the channel frequency + or - 167 kHz

** - The nominal channel frequency, Fc (in Megahertz) of the multiplex can be calculated using Fc = 8n+306, where ‘n’ is the UHF channel number

VHF (FM) Radio Transmission Frequencies

Service	Frequency (MHz)	Transmitter Power (kW)
BBC Radio 1	98.9	250
BBC Radio 2	89.3	250
BBC Radio 3	91.5	250
BBC Radio 4	93.7	250

Table B - Holme Moss VHF (FM) Radio Services

Information correct at time of writing. Information provided by DigitalUK and Arqiva

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Signal Measurements

Measurement Point Number	Channel	32	34	35	29	49	37	55
	Frequency	562.00	578.00	586.00	538.00	698.00	602.00	746.00
	Service	BBC A	D3&4	BBC B	SDN	Arqiva A	Arqiva B	COM7
1	FS	90.0	94.2	92.6	88.0	88.5	89.9	81.7
	CSI	23.4	22.3	-	22.6	22.8	22.8	-
	MER	32.2	31.3	-	32.6	31.7	32.5	-
2	FS	89.7	96.0	92.3	82.1	88.7	89.9	81.2
	CSI	21.7	24.2	-	23.0	24.0	22.1	-
	MER	31.3	32.5	-	30.9	31.0	33.4	-
3	FS	95.9	84.3	92.1	93.5	96.4	89.4	85.2
	CSI	27.9	24.8	-	19.7	22.6	25.1	-
	MER	31.8	32.6	-	31.5	32.6	32.6	-
4	FS	93.9	91.7	91.5	90.9	96.8	90.0	89.6
	CSI	22.0	25.5	-	23.6	21.8	28.7	-
	MER	31.0	29.9	-	33.4	32.6	33.1	-
5	FS	90.7	90.0	92.7	86.8	90.5	83.8	80.9
	CSI	19.8	21.5	-	20.2	22.6	25.2	-
	MER	31.5	31.5	-	33.6	31.1	30.7	-
6	FS	96.7	92.1	97.9	93.3	94.9	93.5	84.0
	CSI	20.8	20.4	-	21.2	18.7	18.4	-
	MER	33.1	32.0	-	32.1	31.5	31.0	-
7	FS	85.7	92.2	86.1	90.2	87.6	89.9	77.1
	CSI	23.1	21.9	-	19.6	23.2	22.5	-
	MER	30.2	32.4	-	30.0	32.9	32.4	-
8	FS	88.9	88.7	90.0	94.1	92.3	94.0	91.6
	CSI	22.3	20.8	-	24.5	23.7	20.0	-
	MER	33.6	33.0	-	30.2	31.1	31.6	-
9	FS	89.3	90.2	88.5	94.0	91.2	90.9	82.7
	CSI	23.4	30.9	-	27.3	23.6	27.2	-
	MER	31.4	32.6	-	34.3	33.0	30.6	-
10	FS	93.7	84.3	93.3	90.1	94.4	89.0	91.4
	CSI	26.2	26.5	-	21.2	21.4	28.5	-
	MER	30.3	32.4	-	33.1	33.3	32.4	-
11	FS	91.7	90.2	89.0	95.8	87.5	94.1	89.7
	CSI	21.6	26.7	-	23.7	21.0	30.0	-
	MER	33.2	30.2	-	32.8	30.8	32.8	-
12	FS	92.4	87.6	96.0	92.3	97.9	91.2	78.2
	CSI	20.2	20.6	-	21.3	25.7	25.4	-
	MER	32.2	33.1	-	31.9	30.0	33.7	-

Table C - Field Strength Measurements of Winter Hill Digital Television Services

Frequencies listed are in MHz
Field strength (FS) values are indicated in dBµV/m
CSI Channel Status Information (%)
MER Modulation Error Ratio (dB)

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Location	Service	Radio 1	Radio 2	Radio 3	Radio 4
1		63.6	69.4	68.7	61.0
2		66.9	61.9	70.8	69.3
3		61.3	67.0	59.2	61.0
4		64.7	67.0	69.9	68.9
5		63.0	64.7	67.3	68.0
6		61.9	60.5	65.1	60.6
7		67.1	69.7	69.6	65.9
8		67.0	60.6	68.8	67.6
9		69.0	68.9	64.6	68.8
10		62.6	66.1	65.1	70.0
11		68.0	72.9	75.6	72.9
12		66.5	64.5	68.0	65.5

Table D - Field Strength Measurements of Holme Moss VHF(FM) Radio Services

Field strength (FS) values are indicated in dBµV/m

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An Overview of Signal Measurements

The first and easiest parameter to check is signal level (also referred to as amplitude or terminated signal strength). In many cases this gives a good indication of the available decoding margin, or the extent of any shortfall.

At the receiver input, the terminated level of a DTT signal is measured in the usual units of dBµV (a maximum signal level of 70 dBµV and a minimum signal level of 50 dBµV). It is helpful to understand that the level of a DTT signal represents the total power of all the carriers in the Coded Orthogonal Frequency Division Multiplexing (COFDM) signal and not the level of each individual COFDM carrier. For satisfactory reception of digital signals, it is important the signals applied to the receiver are within these ranges. These maximum and minimum levels define a so-called window of operation for the receiver.

Common practice dictates that in order to measure the quality of a received DTT signal we have to look at one or more of the following parameters: Bit-Error Rate (BER), Channel BER (CBER), Carrier-to-Noise Ratio (CNR) and Modulation Error Ratio (MER). The Channel State Information (CSI) feature available in DTT measurement equipment is a very valuable tool providing additional insight into the quality of reception in a typical domestic or professional DTT installation.

Using the BER alone is an ill-advised “hit-or-miss” strategy because of the 'cliff-edge effect' characteristic of any digital TV system. A BER reading below the reference quasi error free (QEF) value of 2×10-4 might wrongly lead us to conclude that the receiving conditions are satisfactory.

However, the BER provides a very narrow signal measurement range. Even for vanishingly small BER readings, a small drop in the level of received DTT signal can push the DTT receiver over the digital cliff edge beyond the point of system failure. The CBER is closely related to the BER providing a wider signal measurement range. Depending on the type(s) of unknown disturbance(s) affecting our DTT installation (noise, co-channel or adjacent PAL, co-channel DTT, etc.), the CBER corresponding to the reference QEF BER of 2×10-4 varies between 4 and 7 in 100 [1]. Unfortunately, the CBER is not a reliable indicator of how far the digital cliff edge is.

DTT engineers need a tool with a wide measurement range that solves the shortcomings of the BER and CBER. This measurement tool should provide some estimate of the noise margin of the DTT installation. A first candidate comes to mind: CNR or, alternatively, its sibling the MER.

The CNR is defined as the ratio of the average RF power of the DTT signal to the power of the noise present in the UHF channel. Similarly, the MER is defined as the ratio of the average power of the DTT signal to the average power of the constellation errors. It can therefore be used to give a more direct indication of decoding margin when, as is often the case, there is co-channel

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interference as well as noise in the channel. The higher the MER value, the **better** the reception conditions. Our measurement equipment provides a maximum MER measurement value of up to 35 dB.

In situations where there is no multipath propagation so that the channel frequency response remains reasonably flat, CNR and MER are in principle the same thing. In practice, the accuracy of the measured CNR is limited by the noise floor of the measurement equipment and by the presence of other disturbances on adjacent UHF channels. Likewise, both the receiver's noise floor and other issues resulting from its practical implementation degrade the MER estimate.

Channel State Information (CSI)

Some flavour of CSI is used internally by all commercial DTT receivers to achieve the recommended target system performance[4]. The CSI counts the effect of both the noise present in the channel and the shape of the transmission channel itself. In other words, the CSI gives a measure of the reliability of the received DTT signal. We measure the average of the CSI across the UHF channel occupied by the DTT signal. The higher the percentage value of CSI, the **less** reliable DTT reception is.

As explained, the CSI can be used as a means to measure the noise margin in a DTT installation. Let us call CSI_{QEF} the percentage CSI measured at the point where the measurement equipment displays the reference QEF BER. The noise margin in dB is then approximately given by –

$$NM\ (dB) = \frac{CSI_{QEF} - CSI}{2.6}$$

This empirical approximation represents a good estimate for NM below 8dB. The CSI alone, on the other hand, has a wider measurement range, providing meaningful results for NM of up to 15dB.

4 *J. Lago-Fernández, "Using Channel State Information (CSI) to Characterize DVB-T Reception", IBC, Amsterdam, 12-17 September 2002*

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Survey Equipment

1 x Promax Prolink 4C Premium – Serial Number PK4COPAB11B / 060419030005 Running firmware version 2.47

1 x Sony Wide screen CRT Reference Receiver KV–16TIU – Serial Number 4014480

1 x Professional Broadcast Wideband Log Periodic 8 element antenna – Amphenol Jaybeam (details below)

Amphenol JAYBEAM 468-860 MHz

A Log Periodic antenna designed for UHF Broadcast, TETRA and Cellular communications applications. This antenna is often used in a stacked array to form a rugged, high power, extended range antenna. Produced to the highest quality standards, these robust antenna designs will insure reliable operation in harsh environmental conditions.

LPU/Rx

V-Pol or H-Pol | Log Periodic | 70° | 7.9 dBd

Replace "x" with desired model number option.

Electrical Characteristics		
Frequency band	468-860 MHz	
Model number options (x)	Model Number LPU/R-N LPU/R-7/16	Connector type N-Female 7/16-DIN Female
Polarization	Vertical or Horizontal	
Horizontal beamwidth	70°	
Gain	7.9 dBd	
Impedance	50Ω	
VSWR	<1.3:1	
Maximum power	250 W	
Connector type	see model number options above	
Lightning protection	DC grounded	
Mechanical Characteristics		
Materials	Aluminium Alloy	
Dimensions (Length x Width)	1210 x 320 mm	47.6 x 12.6 in
Weight without bracket	3.5 kg	7.7 lbs
Mounting Options		
Mounting	Mounting bracket included to fit 38-50 mm dia. pipe.	

Technical Specification for an Amphenol Jaybeam Professional Broadcast Wideband Log Periodic 8-Element Antenna

All RF cables, interconnects and systems of professional quality and calibrated to determine feeder losses and antenna gains. These are factored into the results, providing accurate descriptions of actual field strength values at 10m AGL for each surveyed location – see *Calculation of Received Field Strength*

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Calculation of Received Field Strength

The Field Strength (dBµV/m) is derived from the Terminated Level (dBµV) as measured at the input of the Promax measurement receiver in the survey vehicle.

Field Strength (dBµV/m) = Terminated Level (dBµV) – Aerial Gain (a) + Dipole Factor (b) + Feeder Loss (c)

where -

Dipole Factor (to matched load)	(b)	$20Log(\frac{2\pi}{\lambda})$ *Where λ = Transmission Wavelength (m)*
Feeder Loss	(c)	3 dB
Aerial Gain (dB_{dipole})	(a)	10 dB

References

The building information found in Chapter 2 was sourced from the following Ofcom document –

http://licensing.ofcom.org.uk/binaries/spectrum/fixed-terrestrial-links/wind-farms/tall_structures.pdf

Mapping Data

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Planning Policies - National Planning Policies

National Planning Policy Framework (NPPF), Ministry of Housing, Communities & Local Government, February 2019

10. Supporting high quality communications

114. Local planning authorities should not impose a ban on new electronic communications development in certain areas, impose blanket Article 4 directions over a wide area or a wide range of electronic communications development, or insist on minimum distances between new electronic communications development and existing development. They should ensure that:

a) they have evidence to demonstrate that electronic communications infrastructure is not expected to cause significant and irremediable interference with other electrical equipment, air traffic services or instrumentation operated in the national interest; and

b) they have considered the possibility of the construction of new buildings or other structures interfering with broadcast and electronic communications services

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Planning Policies - Regional and Local Planning Policies and Guidance

Manchester City Council (MCC), "Full, Outline, Reserved Matters & Variation/Removal of Conditions Planning Applications - Is Your Application Valid?", September 2018, MCC

Broadband Connectivity Assessment

All new build residential developments must incorporate measures to facilitate digital connectivity for all new build residential properties having regard to the Data Ducting Infrastructure Guidance produced by the Department for Communities and Local Government. (Section 10 NPPF, above)

Television Reception

MCC planning guidance, any development over four storeys requires a TV reception impact assessment.

Information on TV and radio reception and interference. Please provide a report on the possible interference created by the proposed development on TV and radio reception within the area. You may wish to contact the Office of Communications (Ofcom) on tel. 0207 981 3000 for suggestions of companies who may be able to carry out such work. (Core Strategy Policy EN2)

Tall Buildings

If the proposed building is considered to be a 'Tall Building', you will need to make a case for the height of the tall element and take into consideration Historic England and Design Council guidance on 'Tall Buildings'. The design statement should make reference to Design Council guidance to assess its impact on the surrounding area. A visual impact assessment with visualisations of the building form key views needs to be included. The statement should include details of pre-application discussions held with local residents and the outcome of these discussions. If the Proposal is a Tall Building, it may require an Environmental Statement, as it would have the potential to generate significant impacts over and above the existing use(s) on site. Most notably impacts relating to visual impact; wind microclimate; sunlight / daylight / shading / solar dazzle / privacy and overlooking; transport issues; noise and vibration; air quality; ground conditions and contamination; water resources hydrology; ***radio and television interference****; and sustainability. (Core Strategy Policy EN2)*

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The UK's terrestrial television and radio networks are highly complex engineering systems and are constantly being modified, re-designed, upgraded and maintained. The reception conditions detailed in this report were those prevailing at the time of the survey in the study area. Engineering work at transmitter sites, weather conditions and the time of the year will influence the quality and coverage of terrestrial services and their susceptibility to interference. Whilst every effort was made to accurately measure and assess the available television and radio transmissions and services at the time of the survey, GTech Surveys Limited cannot assume that any part of the television or radio broadcast network or transmission from any transmitter was operating in required specification or correctly to any design criteria. The signal measurements undertaken during the survey work were used to define the possible impacts to television and radio reception for this project. Although best practice has been applied in understanding the potential impacts, due to the complex nature of the subject, GTech Surveys Limited is not accountable in anyway whatsoever if unpredicted impacts occur at any location anywhere in the study area.

Modelling parameters assume that all installed UHF antenna systems are mounted at least 10m AGL and installed to a modern standard, with all components meeting CAI quality standards. Antennas mounted at lower heights and poor-quality installations will be more prone to the effects of interference from external sources and as such, reception conditions to installations with the aforementioned characteristics have not been accounted for in any impact modelling. Consequently, properties with such installations may be prone to interference effects that have not been identified. Such installations are commonly found in camping and caravan parks, on bungalows and properties where it is not possible to attach an antenna to the exterior roof. Antennas mounted in lofts are also more prone to interference effects arising from the signal attenuation caused by roofing materials. Again, reception conditions to properties with the aforementioned antenna installation characteristics have not been accounted for in any impact modelling and as such, properties with these installations may be prone to interference effects that have not been identified.

Digital terrestrial television (Freeview) coverage may vary as a result of engineering works or any frequency changes authorised by Ofcom. We advise that consumers always check future reception predictions (http://www.digitaluk.co.uk/coveragechecker/) before buying TV equipment. GTech Surveys Limited, Ofcom and Digital UK are not responsible for household TV reception arrangements.

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Any questions or matters arising from this Report should be addressed in the first instance to the Project Manager.

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